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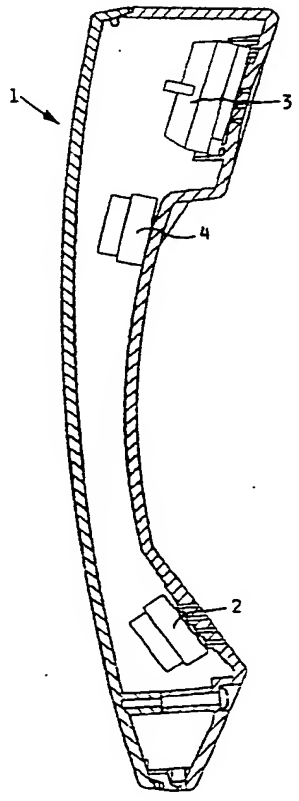
(54) Title: A NOISE SUPPRESSING TELEPHONE HANDSET

(57) Abstract

The handset (1) of a telephone instrument, which contains a microphone (2) and a receiver (3) arranged in ordinary manner, is additionally provided with a second microphone (4) which is negatively fed back to the first microphone (2). The second microphone (4) is electrically negatively fed back to the first, ordinary microphone (2) and is arranged in the vicinity of the receiver (3), and, like the first microphone (2), it is directed toward the user's face. These two microphones thereby substantially outbalance the remote field and reduce noise, while they affect the speech sensitivity only to an insignificant degree such that improved signal/noise ratios are obtained.



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A noise suppressing telephone handset

The invention concerns a telephone instrument of the type stated in the introductory portion of claim 1.

In contrast to older telephone instruments with carbon microphones, modern telephone instruments with electronic speech transmission circuit and with electromagnetic, electrodynamic, piezoelectric or electret microphones are highly sensitive to the acoustic remote noise field.

To remedy this long-known problem numerous variants of said microphone types have been manufactured in the course of time, constructed as a pressure gradient microphone with acoustic passage to both sides of the diaphragm. The advantage of this is that the remote noise field affects the two sides of the diaphragm in the same manner and is thus outbalanced, while the near field, i.e. the direct speech against the front side of the diaphragm affects the rear side of the diaphragm only to a very limited degree. An acceptable total speech sensitivity can therefore be achieved.

However, this applies only in case of direct speech into the microphone. On the other hand, the slightest displacement of the microphone end from the optimum position close to the mouth will cause a drastic reduction in speech sensitivity, because the impedances from the mouth to the front side and the rear side, respectively, of the diaphragm approach each other so that also the near field will be outbalanced.

The remote field sensitivity is in both cases approximately the same for frequences below 1 kHz, but only with an optimally positioned handset is the signal/noise ratio

acceptable.

Furthermore, all these previously known solutions have been based on special transducers which are relatively complicated because suitable acoustic impedances are to be obtained at both sides of the diaphragm. These transducers are more expensive to manufacture than standard microphones, and since they are moreover just produced in a relatively small number, it is clearly a costly solution.

The Patent Abstracts of Japan, JP 1-42966 discloses a telephone instrument of the type stated in the opening paragraph. In this, the two microphones are of different types, and precisely because different microphones are used with different direction and frequency characteristics, it is necessary to adjust the substraction means of the microphones, i.e. an additional circuit for the connection of the microphones.

The object of the invention is to produce a telephone with a handset of the type stated in the opening paragraph, which is better and cheaper than the known noise-reducing handset.

This object is achieved according to the invention in that the second microphone is identical with the first microphone, that the second microphone is negatively fed back to the first microphone, and that it is arranged at a distance from the first microphone.

Preferably, the second microphone is arranged near the receiver and is directed towards the face in the position of use like the first microphone.

The two microphones are preferably two uniform standard microphones which are mass-produced and are therefore in-

expensive.

The distance a from the mouth opening to the openings in the handset to the first microphone is about 18 mm. The distance b from the mouth opening to the openings of the handset to the second microphone is about 120 mm.

In the near field the pressure decreases more than proportionally to the increase in distance, i.e. when inserting the second microphone the sensitivity deterioration is less than:

$$20 \log \frac{1}{1 - \frac{18}{120}} = 1.4 \text{ dB}$$

If the microphone end of the handset is no longer kept optimally, but is lowered e.g. 50 mm, whereby the distance a from the mouth to the first microphone increases to 53 mm, the distance to the second microphone will still be considerably greater than the distance to the first microphone, so that the microphones will still have speech sensitivity.

In all cases, the acoustic impedance of the remote field or the noise signal will be approximately the same for the two microphones since both of them are directed toward the face with the same distance to the skin. The noise signal will therefore be well outbalanced to a degree depending upon the type and position of the noise sources.

Since the distance between the microphones corresponds to the halfwave of the acoustic oscillation of 1.5 kHz, the second microphone will be in phase with the first microphone at this frequency and will therefore cause a slight increase in sensitivity. This is not desirable, and the

input holes to the acoustic volume in front of the second microphone are therefore constructed as an acoustic low-pass filter with a cut-off frequency of about 1.5 kHz. The outbalancing of the remote field will therefore be limited to frequences below 1.5 kHz, and it is also in this low frequency range that the most speech recognition disturbing noise generators occur. According to the invention it is possible to outbalance the remote field entirely without using subtraction means, solely because both microphones are serially connected in opposition. In this series coupling, the reduction of the near field sensitivity of the original microphone can easily be kept below 2 dB with a number of alternative positions of the second microphone. It should be mentioned that the smaller the distance between the microphones, the greater the frequency range covered. The input openings and the volume in front of the second microphone are arranged such that the cut-off frequency of the acoustic low-pass filter formed thereby reduces the sensitivity of this microphone outside the desired frequency range.

An additional advantage of the microphone of the invention over the microphone in JP 1-42966 is that because of the two identical microphones there is no need for a connection and disconnection facility like in JP 1-42966, just as the subtraction means in JP 1-42966 adds to the costs. Finally, the two microphones in JP 1-42966 cannot be serially connected because they are different.

Finally, it is an advantage that the handset of the invention does not require additional power supply wires like the Japanese publication. Accordingly, telephone instruments can freely be supplied with one or two microphones without there being any other differences.

Preferred microphone types are electromagnetic or in particular electrodynamic ones rather than electret microphones, because it is then possible to manufacture handsets according to the invention which can readily replace existing handsets without noise reducing properties, without having to change the actual telephone instrument.

It should be mentioned that also noise produced by scratching on the handset is outbalanced by the two microphones.

The invention will be described more fully below with reference to the drawing, in which

fig. 1 shows a handset according to the invention seen from the side facing the user's head,

fig. 2 is a longitudinal section through the handset of fig. 1, and

fig. 3 shows a measured comparison between noise transfer via a handset according to the invention, curve A, and a known handset, curve B.

The drawing shows a handset 1 which contains a first, ordinary microphone 2 and a receiver 3. Also a second microphone 4 is mounted near the receiver 3, as shown in fig. 2. The microphones are uniform standard moving coil microphones which are directed toward the user's face, the handset being formed with openings 5 and 6 for the first microphone and the second microphone, respectively, and openings 7 for the receiver 3. These openings are shaped so as to form suitable acoustic impedances for the subject three transducers 2, 3 and 4. The openings 6 moreover form an acoustic low-pass filter which cuts off frequences above 1.5 kHz.

Fig. 3 shows a measurement result obtained by letting the handset transfer a random, but constant noise field from its surroundings, i.e. a remote field through a telephone link, the noise being measured in dB at the receiver end, distributed over the actual frequency range.

The curve A shows the measurement for the handset of the invention, and the curve B shows the measurement for the same handset, but with the openings 6 closed, so that the noise compensating effect of the microphone 4 is cancelled.

As appears from fig. 3, there is an improvement of about 5 to 10 dB over the entire essential frequency range from about 300 Hz to 1.5 kHz.

Patent Claims:

1. A telephone instrument with a handset containing in ordinary manner a first microphone and a receiver as well as a second microphone for suppressing room noise, characterized in that the second microphone is identical with the first microphone, that the second microphone is negatively feed back in series with the first microphone, and that it is arranged at a distance from the first microphone.

2. A telephone instrument with a handset according to claim 1, characterized in that the second microphone is arranged near the receiver and is directed toward the face in the position of use like the first microphone.

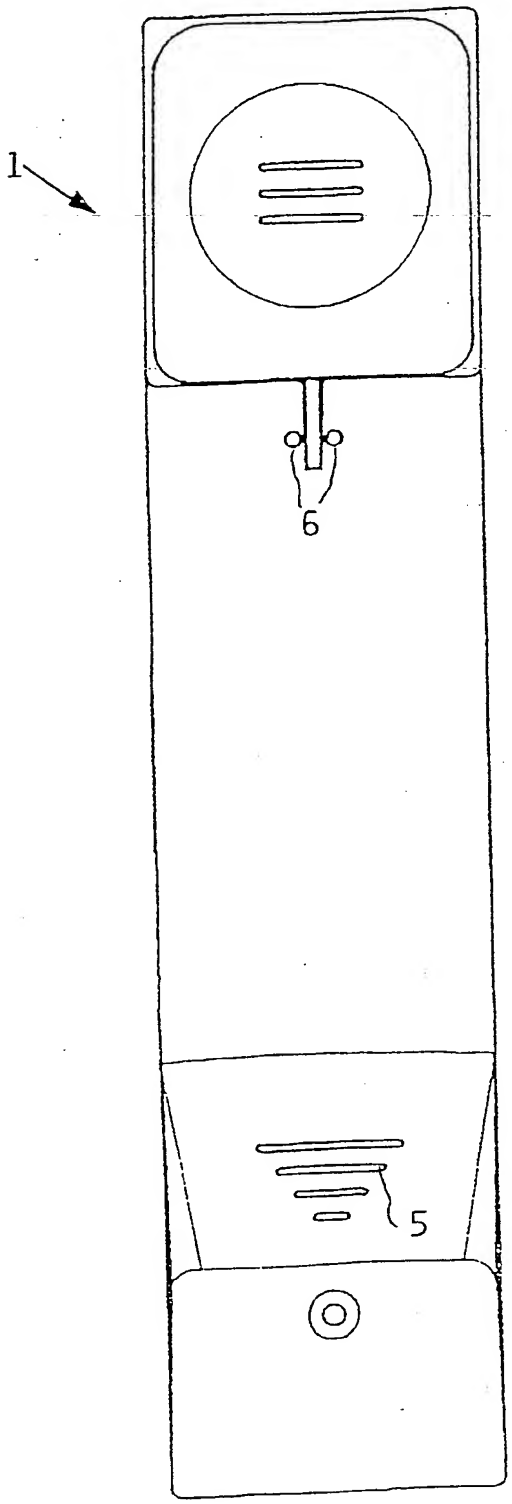


FIG. 1

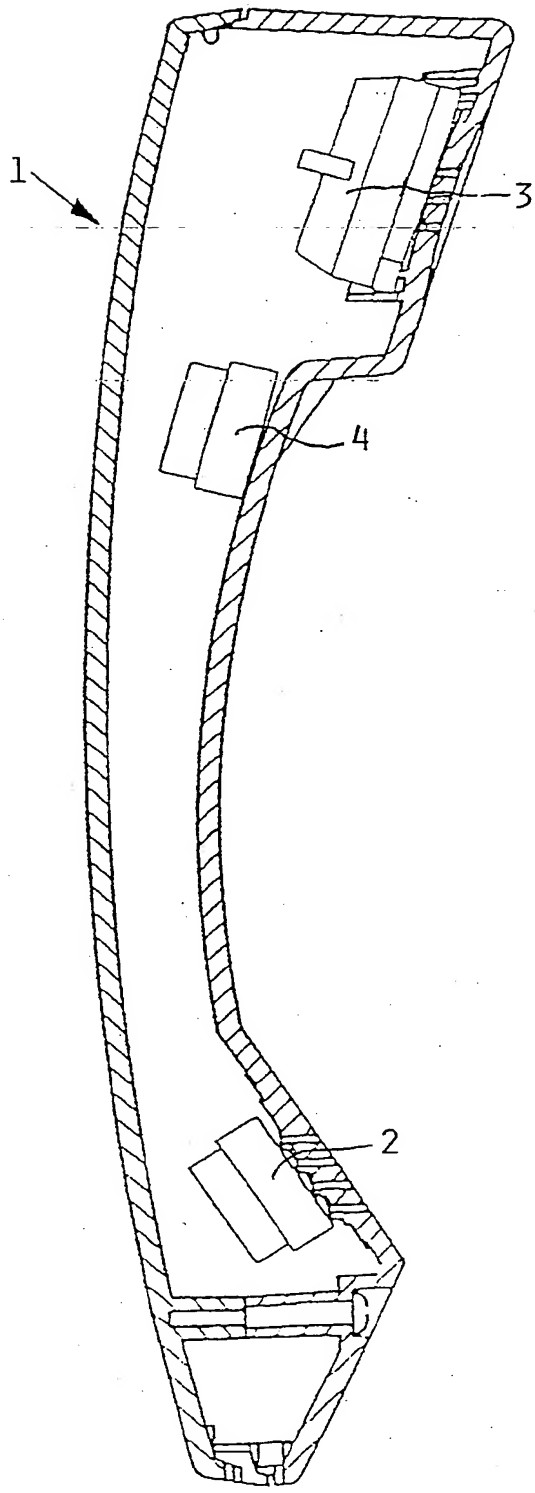
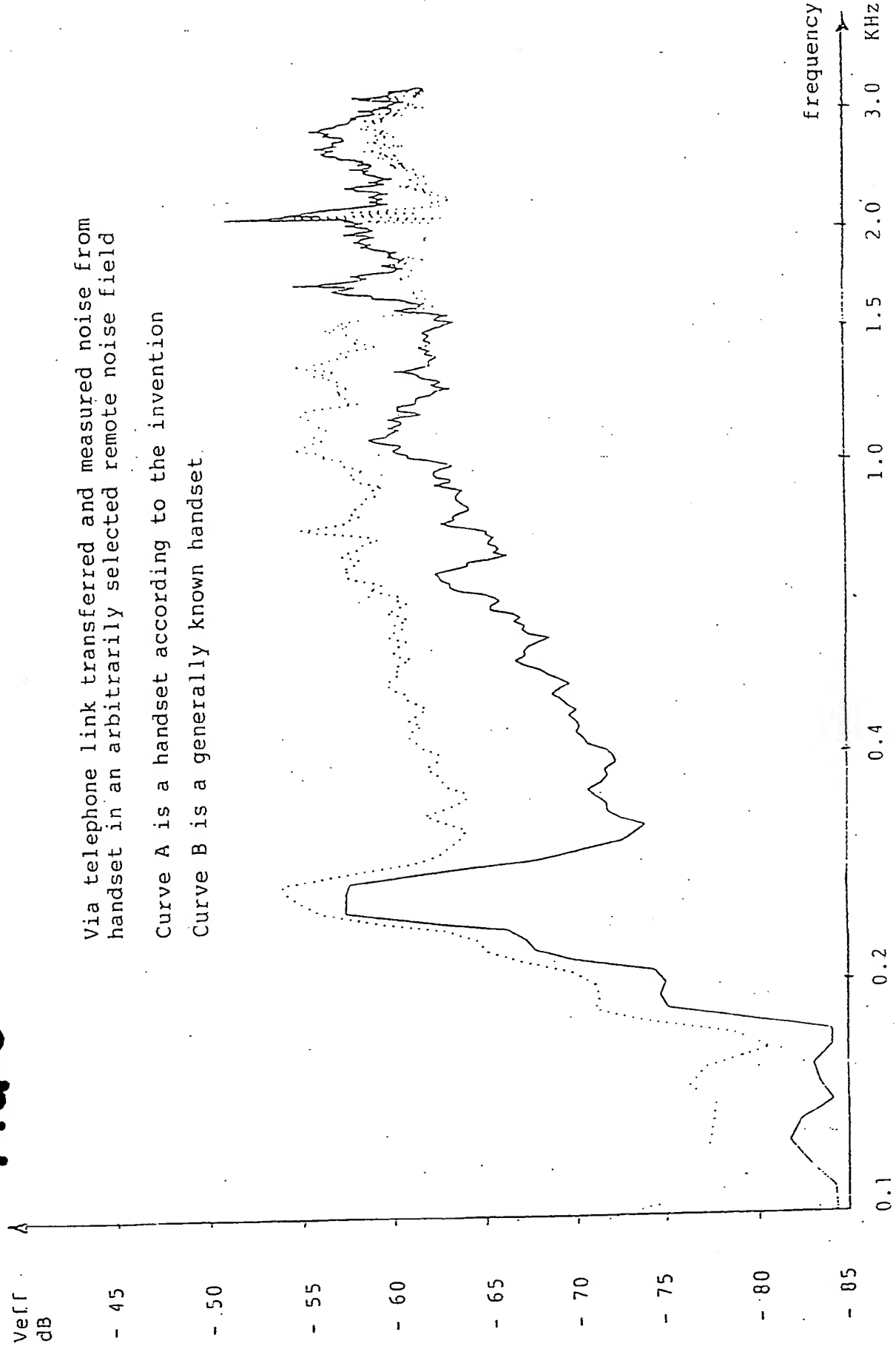


FIG. 2

FIG 3



INTERNATIONAL SEARCH REPORT

International Application No PCT/DK 92/00091

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: H 04 M 1/19

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	H 04 M

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	Patent Abstracts of Japan, Vol 13, No 86, E720, abstract of JP 63-263865, publ 1988-10-31 NEC CORP. --	1-2
A	US, A, 4773091 (ALAN C. BUSCHE ET AL.) 20 September 1988, see abstract; figure 1 --	1-2

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* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15th June 1992	1992 -06- 29
International Searching Authority: SWEDISH PATENT OFFICE	Signature of Authorized Officer: MICHAEL FELHENDLER

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/DK 92/00091

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 29/05/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4773091	88-09-20	NONE	